CLIMATE NARRATIVE, November 2020 and as noted

How will we predict the future if we cannot see the present?
Climate_Narratives may be found,
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html Jerrold.G.Norton@noaa.gov

UNITED STATES WEST COAST AND NORTH PACIFIC

During late **November** 2020 average to below average sea surface temperatures (neutral to negative SST_N anomalies from 0°C to 2.5°C) occurred coastally (20-300 km offshore) from Baja California to Northern California (26°-41°N). These areas were most developed in intensity and offshore extent (300-700 km) from central California (36°N) to Cape Mendocino (40.4°N). Less anomalous SST_N and neutral conditions reached from central Oregon to Alaska and across the Pacific north of 55°N. Off coastal Canada and Alaska, these average SST_N replaced the persistent positive SST anomalies of previous months. Areas of anomalously high SST_N persisted (meridionally dependent) across the Pacific between 15°-45°N. Positive SST_N anomalies (≤2.5°C) also persisted in the western Pacific from northern Australia to Korea and Japan (10°S -45°N). South of 10°N, an expanding tongue of negative SST_N anomaly reached from the coast of South America westward to 160°E, as La Niña conditions intensified through November.
https://www.ospo.noaa.gov/Products/ocean/sst/anomaly/
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)
https://coastwatch.pfeg.noaa.gov https://climatereanalyzer.org/wx/DailySummary/#sstanom (current)
https://www.ospo.noaa.gov/Products/ocean/sst/contour/index.html
https://psl.noaa.gov/data/gridded/data.noaa.oisst.v2.highres.html
https://www.fisheries.noaa.gov/feature-story/central-gulf-alaska-marine-heatwave-watch?utm_medium=email&utm_source=govdelivery

Late November **Sea Level Height Anomaly** (SLA) analyses for the Pacific Ocean (30°S-40°N) showed deepening negative SLA (≥-20 cm) along the coast of North America from the equator northward beyond 40°N, coincident with negative coastal SST_N anomaly. Between 0°-18°N these negative SLA anomalies (≥-20 cm) extended from the coast to 160°E. The most developed troughs occurred at the equator and 12°-14°N. At 150°E, in the western Pacific, positive SLA anomaly (≥20 cm) occurred from the equator to 12°N, where there was transition to negative SLA that extended to 33°N. North of 35°N, SLA was positive from 140°E across the North Pacific to 130°W.
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ocean/weeklyenso_clim_81-10/wksl_anm.gif (current)

During late November, coastal areas with **surface chlorophyll-a** (chl-a) concentrations of 0.5- 2.0 mg/m^3 were seen in NOAA / VIIRS satellite imagery along shore U.S. from 28°-52°N. This coastal zone of high chl-a reached between 400-900 km off the west coast. The higher concentrations occurred within 200 km of the coast between 34°-37°N. North of 47°N, patches (>10^5 km^2) of elevated chl-a reached from the U.S coast across the north Pacific. However, much of this area is covered by clouds during winter months, limiting visual analysis. Coastal areas with 0.5- 1.5 mg/m^3 were generally 50-150 km offshore southern California and northern Mexico (30°-33°N). Lower chl-a oceanic water (0.05-0.09 mg/m^3) was found within 150 km of shore south of 30°N and across the temperate Pacific. https://coastwatch.pfeg.noaa.gov/coastwatch/CWBrowserWW180.jsp#
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)
https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdVHNchla8day.graph?chla%5b(2021-12-31T00:00:00Z)%5d%5b(0.0)%5d%5b(83.65125):(-0.10875)%5d%5b(-180.03375):(-110.00625)%5d&.draw=surface&.vars=longitude%7Clatitude%7Cchla&.colorBar=%7C%7C%7C%7C%7C&.bgColor=0xffccccff

Monthly sea temperature from shore stations and **near-shore buoys,**

The following list gives shore and nearshore water temperature measurement locations along the U.S. west coast in decreasing latitude. Each line begins with a shore station or buoy abbreviation followed by latitude. Temperature values are in brackets with the average of available month's values first (followed by the range and standard deviation) in parenthesis and change from previous monthly mean. Temperature averages for the first, second and third monthly terciles are within the second parenthesis, followed by the multiyear monthly average, where available. Subscripts H and L show the tercile where the highest and lowest month's temperatures were recorded.

Inshore cooling is indicated by decrease in averages from October to November. Additional general observations include: 1) temperature range of monthly averages was 9.5°-16.5°C, 2) overall monthly averages are below available multiyear averages, 3) greatest change during the month is between the first and second tercile, 4) highest temperatures generally occur in the first tercile and lowest temperature often occurs in second tercile and 5) monthly standard deviation is less than one at 37.8°N (SFrn) northward and one or more to the south. * marks partial records. The notes section provides additional detail on the rapid changes in coastal surface layer temperature that occurred during November.

Amphitrite Point, B.C. 48.9°N

Neah,48.5°N,124.7°W [10.0 (8.7- 11.8, 0.72) -1.3 (10.1, 9.8, ~10.1) 10.3°C]*

Cape Flattery 48.4°N

NeBy,48.4°N *[9.5(8.6- 10.4, 0.38) -1.4(9.7$_H$, 9.3$_L$, 9.5)°C]*

CpEz,47.4°N,124.7°W [10.5(9.4- 12.6, 0.79) -3.1(11.5$_H$, 10.1$_L$, 9.9) 11.1°C]

Cape Blanco 42.8°N

PrtO,42.7°N *[10.0 (8.8- 10.8, 0.33) -0.8(9.9$_{LH}$, 10.1$_H$, 10.0)°C]*

CCty,41.7° *[10.5(9.2- 12.4, 0.63) -1.9(10.8$_{LH}$, 10.3, 10.4)°C]*

EelR,40.7°N, 124.5°W [11.2 (10.2- 12.7, 0.61) -1.4(11.3, ~10.3, -) 12.0°C]*

Point Arena 39°N

ArCv,38.9°N [11.1 (9.6- 12.9, 0.71) -0.7(11.6L$_H$, 10.9$_L$, 10.7)°C]

Point Reyes 38°N

SFrn,37.8°N,122.8°W [12.3 (11.2- 14.6, 0.90)-1.6(13.2$_H$, 11.9, 11.7$_L$) 12.9°C]

Mtry,36.6°N *[14.7(13.1- 17.2, 0.97) -1.1(15.6$_H$, 13.9$_L$, 14.0)°C]**

Point Sur (36.3°N)

PrtS,35.1°N *[13.2(12.1- 16.4, 1.3) -2.9(14.8$_H$, 12.4$_L$, 12.5)°C]*

PtCn,34.5°N,120.8°W [13.9(11.9- 17.6, 1.11) -3.7(15.2$_H$, 13.4$_L$, 13.2) °C]

Point Conception,34.4°N

SBCh,34.3°N,119.9°W [15.3 (13.6- 18.4, 1.09) -4.1(16.2$_H$, 15.0, 14.6$_L$) 15.7]

SMca,34°N *[15.5 (13.5- 18.8, 1.36) -4.4(16.7$_{LH}$, 14.5$_L$ 15.2)°C]*

Tory,32.9°N,117.4°W [16.5 (14.4- 19.4, 1.16) -4.1(17.5$_H$, 16.1$_L$, 15.9) °C]

LaJo,32.9°N *[16.5(13.7- 19.7, 1.11) -2.8(17.8$_H$, 15.6$_L$, 16.2)°C]*

Point Loma, 32.7°N

Shore temperature measurements, taken at fixed depth below the lowest tide at NOAA **tide stations**, are in italics: *NeBy* (9443090), *PrtO* (9431647), *CCty* (9419750), *ArCv* (9416841), *Mtry* (9413450), *PrtS* (9412110), *SMca* (9410840), *LaJo* (9410230). (Numbers) lead to detailed location and station descriptions,
https://tidesandcurrents.noaa.gov/stations.html?type=Physical%20Oceanography

. Near shore buoy measurement details are obtained from number designations: Neah (46087), CpEz (46041),TlMk (46089), EelR (46022), SFrn (46026), PtCn (46218), SBCh (46053),Tory (46225). https://www.ndbc.noaa.gov/station_page.php?station=46087 * indicates partial record

EQUATORIAL AND SOUTH PACIFIC

During November, La Niña (cool phase ENSO) conditions occurred across the central and eastern equatorial Pacific (EP). La Niña conditions are expected to continue through the northern winter. East of 150°W, negative EP temperature anomalies (≥ -2.5°C) became more extensive from the surface to 200 m. The eastern EP upper 300 m heat content anomaly decreased sharply through October with the lowest 2020 value occurring in the first days of November. Then the heat content anomaly increased through November, suggesting the propagation of an upwelling Kelvin wave across the EP. Globally, the largest area of negative SST_N anomaly (>-2.0°C) was in the EP and off the coast of South America. Negative SST_N anomaly occurred from the South American coast westward into the western South Pacific. Positive SST_N anomaly (≤1.5°C) were more common off the coasts of Australia and Indonesia.
https://www.ospo.noaa.gov/Products/ocean/sst/anomaly/
https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)
https://coastwatch.pfeg.noaa.gov https://climatereanalyzer.org/wx/DailySummary/#sstanom (current)
https://www.ospo.noaa.gov/Products/ocean/sst/contour/index.html https://psl.noaa.gov/data/gridded/data.noaa.oisst.v2.highres.html

During late November **Sea level height anomaly** (SLA) was negative (≥-25 cm) along the coast of North and South America between 30°S-40°N. These areas extended to 160°E in the Equatorial Pacific (EP) and to 140°W at 20°S. In the west, positive SLA anomaly (≤20 cm) occurred from 30°S northward across the equator into Indonesian Seas. http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ocean/weeklyenso_clim_81-10/wksl_anm.gif (current)

The NOAA **Oceanic El Niño Index** (ONI) (3-month running mean of ERSST.v5 anomalies in the Nino 3.4 region) during May-June-July (MJJ), JJA, JAS, ASO and SON were -0.2, -0.4, -0.6 and -1.0, -1.2 respectively, tending toward La Niña thresholds.
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf
https://climatedataguide.ucar.edu/climate-data/multivariate-enso-index (alternate El Niño index)

The NOAA/PSL **Southern Oscillation Index** (SOI) values for January-November 2020 are 0.30, -0.10, -0.20, 0.30, 0.70, -0.60, 0.70, 1.80, 1.50, 0.80, 1.10.
https://psl.noaa.gov/data/correlation/soi.data https://psl.noaa.gov/site_index.html#s https://www.longpaddock.qld.gov.au/soi/

The NOAA/NCEI **Pacific Decadal Oscillation Index** (PDO) increased to -0.61 in October and decreased to -1.65 in November. https://www.ncdc.noaa.gov/teleconnections/pdo/ ,

The **Pacific / North American Teleconnection Index** (PNA), had near neutral values in November, with a monthly "Historical PNA index" of 0.21.
https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml (Historical Index)

November monthly ERD/SWFSC coastal **Upwelling Indices** (UI) were generally small from 24°N to 60°N. UI values were positive at 39° and south and

negative to the north. However, anomalies were positive throughout the computation range. Daily UI computations suggest weak upwelling episodes throughout November at 30°N and an isolated stronger episode at 39°N.
https://upwell.pfeg.noaa.gov/products/PFELData/upwell/monthly/table.2011
https://oceanwatch.pfeg.noaa.gov/products/PFELData/upwell/daily/p11dayac.all https://oceanview.pfeg.noaa.gov/products/upwelling/dnld

PRECIPITATION and RUNOFF

During the final days of November drought conditions remained in southern Oregon and California. Washington and southern Canada had about average rainfall during the October and November (2021 water-year). The lower Columbia Basin, western Washington and northern coastal Oregon had about average rainfall during the October-November period. Southern Oregon and northern California, however, remained in water deficit, with 20% to 70% of normal precipitation. South of San Francisco percentages of normal rain for the water year were less than 10%. See following river discharge information. https://www.cnrfc.noaa.gov/rainfall_data.php
https://droughtmonitor.unl.edu. https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=4
https://waterdata.usgs.gov/ca/nwis/current/?type=flow https://watermonitor.gov/naww/index.php
https://www.cpc.ncep.noaa.gov/products/global_monitoring/precipitation/global_precip_accum.shtml

Northwest and Washington River Discharge

Fraser River discharge, measured at Hope (130 km upriver from Vancouver, B.C.) increased to a maximum of 6,200 m^3/s (218,900 cfs) in early November and fell to 70,640 cfs on 31 November. Median discharge for the station during the highly variable period is 38,850 cfs. https://wateroffice.ec.gc.ca (Station 08MF005)

The **Queets** at Clearwater, Washington was flowing at 4,230 [6,320/ 1160 cfs]-historical median/ change from October to November as cubic feet per second, cfs in brackets] The **Puyallup** at Puyallup was flowing at 1,260 [1,880/ -680 cfs]. **Skagit** flow was 17,700 [16,700/ -2,800 cfs] near Mount Vernon. **Stillaguamish** discharge was 1,880 [2,360/ 220 cfs] at Arlington. The **Columbia** transport was 150,000 [155,000/ (tidal influence) cfs] at Vancouver.

Oregon River Discharge

The **Columbia** at the Dalles, Oregon was flowing at 137,000 [115,000/ 40,100 cfs]. The **Wilson** at Tillamook, was flowing at 990 [1,910/ 758 cfs]. At Elkton, **Umpqua** transport was 2,610 [6,400/ 1687 cfs]. **Roguer** River flow was 1,330 [2,520/ 200 cfs] at Grants Pass and 1,890 [4,940/ 480 cfs] at Agness.

California River Discharge

The **Klamath** near Klamath, California was transporting 3,220 [11,200/ 820 cfs]. **Smith** River. discharge was 770 [4,240/ 577 cfs] near Crescent City. The **Eel** at Scotia had 226 [2,750/ 154 cfs] transport. **Battle Creek,** Coleman National Fish Hatchery flow was 220[340/ -30 cfs]. **Butte Creek** at Chico (environment of California's largest Spring Chinook spawning population) had 96 [172/ 30 cfs] transport. **Sacramento** transport was 8,270 [12,200/ 1740 cfs] at Verona and 8,530 [14,399/ 1,600 (tidal influences)] at Freeport. **San Joaquin** flow was 855 [1,930/ -875 cfs] at Vernalis. **Pescadero Creek** transport 1.8 [5.8/ -0.9 cfs] near Pescadero. **San Lorenzo** discharge was 12.9 [27/ 4.5 cfs] at Santa Cruz. The **Pajaro** River at Chittenden was flowing at 4.4

[14/ 1.8 cfs]. The **Salinas** River near Spreckels had no measurable surface flow from 30 September through 30 November. The **Carmel** at Carmel was flowing at 4.5 [--/ 4.5 cfs]. The **Big Sur** River near Big Sur, California discharged at 19 [26/ 3 cfs] during the final days of November. https://droughtmonitor.unl.edu. https://waterdata.usgs.gov/ca/nwis/nwis
https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=4
https://waterdata.usgs.gov/ca/nwis/current/?type=flow https://watermonitor.gov/naww/index.php
https://www.cpc.ncep.noaa.gov/products/global_monitoring/precipitation/global_precip_accum.shtml
https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=4
https://www.wrh.noaa.gov/cnrfc/rsa_getprod.php?prod=RNORR4RSA&wfo=cnrfc&version=0

Notes for November

Flemming Dahlke and others report observational, experimental, and phylogenetic comparisons of the **thermal tolerance limits of 694 marine and freshwater fish species** at four life stages. Their analysis shows spawning adults and embryos have consistently narrower temperature tolerance ranges than larvae and nonreproductive adults. Although there is considerable variability among species, especially at mid-latitudes, there is generally separation of reproducing adult and embryo life stages from non-reproducing adults and larvae stages, across latitude (0°-80° N/S). This separation of stages is seen in survival temperature maximums, minimums and temperature range. The cardiovascular systems of the ectothermic fishes and their ability to provide sufficient tissue oxygen (aerobic capacity) under conditions of changing temperature and oxygen availability is apparently more taxed in reproductive adults and embryos than in larvae and nonreproducing adults. sciencemag.org: DOI: 10.1126/science.aaz3658Science Vol. 369, No. 6499, DOI: 10.1126/science.abd1272Science Vol. 369, No. 6499

The **Monthly Sea Temperature List from Shore Temperatures and Buoys** (above) is an ongoing effort to monitor the dynamic coastal environment using existing ocean monitoring sites. During November additional detail to the **List** is salient. During the first monthly tercile, sea temperature change of 4°C developed in 1-5 days at the southern sampling locations. This event was observed throughout the west coast system from 32.9°N to 48.5°N. The most rapid changes appeared within the Southern California Bight (32.9-34.5°N). Observations at 34.5°N (PtCn) and 35.1°N (PrtS) had changes of 3.4°C and 3.7°C that occurred over longer 8-10 day periods. At PrtS, a persisting temperature change of 2.2°C occurred in less than a 48 hours. The signal appeared attenuated north of 36°N where temporally corresponding changes were generally less than 3°C. Exceptions occurred at 37.8°N (SFrn) and 48.5°N (Neah) where changes were greater than 3°C. Local processes may have accentuated the more wide-spread or remotely forced process at SFrn and Neah. A two-phase monthly process occurred at 38.9°N (ArCv) and northward, where there was a general raise in sea temperature after initial decrease. Then temperature decreases of 1 -2°C occurred near the 20th of November. At 47.4°N (CpEz), the initial decrease in temperature was followed a low variability period of lower temperature until the end of November, in patterns characteristic of the southern records. Rapid cooling (upwelling) in the interior of the eastern equatorial Pacific (EP) during October may be linked through Kelvin wave flux to the extreme cooling event off the western U.S. in November. However, propagation is not clear in present surface temperature analyses. Consequently, the event may have originated by coastal processes within the local coastal region or to the south. The sequential dual cooling events seen in the temperature records north of 38.9°N may be related to seasonal cooling of the Northeastern Pacific.